IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Human Journals
Review Article
April 2024 Vol.:30, Issue:4

A Review on Orodispersible Liquisolid Compacts – A Novel Approach to Enhance Solubility and Bioavailability

IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Chandini V S*, Jancy Rani S, Ramesh Kumar K, Gokula Kannan N, Janaki D

** Department of Pharmaceutics, College of Pharmacy, Madras Medical College, Chennai – 600 003 India.*

Submitted: 20 March 2024
Accepted: 27 March 2024
Published: 30 April 2024

ijppr.humanjournals.com

Keywords: Orodispersible, Liquisolid System, Bioavailability, Solubility, Powder Solution Technology

ABSTRACT

The orodispersible liquisolid system is a combination of liquidsolid technology and an orodispersible system. One major obstacle for the development of pharmaceutical dosage forms is the slow dissolution rate of water-insoluble drugs. The Liquisolid approach has been used to enhance drugs that dissolve slowly in water. These are compact, flowable powdered versions of liquid medications. Improving the solubility, rate of dissolution, and bioavailability of drugs that are highly lipophilic and poorly soluble in water is the main objective of developing liquisolid systems. Patients are administered orally dispersible tablets, which circumvent the liver metabolism, facilitate rapid action by dispersion in the mouth without the need for water, and are suitable for both geriatric and pediatric patients. A liquisolid system can be used to enhance the dissolving properties of drugs that dissolve poorly in water. The primary objective of this review is on the theory and application of the liquisolid compact technique to improve solubility and bioavailability.

INTRODUCTION

Given the high level of patient compliance, the oral route has been the most widely employed technique for drug administration over the years. Solubility is one of the key components needed to get an adequate drug concentration in the systemic circulation. Recent years have seen limited water solubility in about 70% of novel drug candidates and 40% of marketed drugs in oral rapid release dose form exhibits low aqueous solubility [1]. If the drugs are to be taken orally, it must be thoroughly dissolved in the gastrointestinal fluid to ensure adequate absorption [2]. Usually, hydrophobic drugs are practically insoluble, very barely soluble, slightly soluble, and sparingly soluble. The difficulties in absorbing drugs that are poorly soluble in water lie in increasing the rate of dissolution, which is the rate-limiting step for all of the pharmaceutical substances discussed above. As a result, these drugs' absorption and bioavailability were improved [3]. The Biopharmaceutical Classification System (BCS) assesses three main factors that determine the rate and extent of oral drug absorption from immediate-release solid oral-dosage forms: dissolution rate, intestinal permeability, and solubility. These factors are combined with the in vitro dissolution characteristics of the drug product. The dissolution process is a rate-controlling step for BCS class II and IV drugs, which determines the rate and extent of their absorption. Water-insoluble drugs' poor rate of dissolution is one of the major issues facing the pharmaceutical industry [4]. One of the major challenges facing scientists working on pharmaceutical formulation is the poorly soluble drugs. Some of the main formulation techniques that have been shown to improve the dissolution characteristics of water-insoluble drugs include the use of water-soluble salts and polymorphic forms, reducing particle size to increase surface area, the formation of water-soluble molecular complexes, solid dispersion, co-precipitation, lyophilization, microencapsulation, and the inclusion of drug solutions or liquid drugs into soft gelatin capsules. Numerous studies have demonstrated that the most potential approach for increasing the pace at which poorly soluble pharmaceuticals dissolve is the liquisolid technique [5].

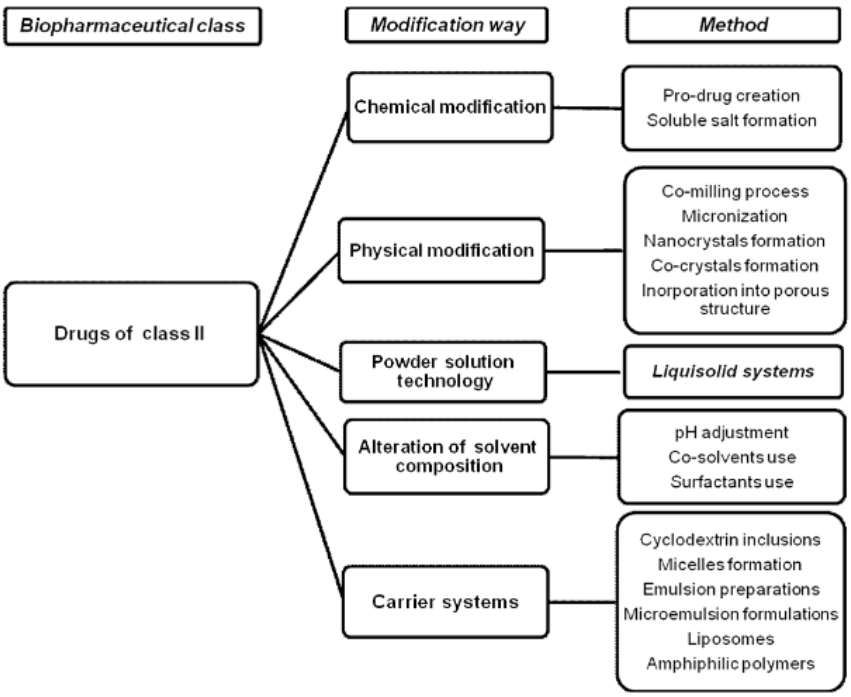

Figure No. 1: Methods to improve solubility [6]

LIQUISOLID SYSTEM

According to Spireas, the liquisolid technology enables liquids to be readily transformed into free-flowing, readily compressible, and seemingly dry powders through an ordinary physical blending process using specific excipients known as the carrier and coating material. The liquisolid technique is a unique way to administer drugs orally. This method works well for immediate or sustained release formulations, highly permeable drugs (BCS Class II drugs), and poorly soluble or water-insoluble drugs without requiring any additional modifications, a liquid lipophilic drugs can be converted into a liquisolid system. On the other hand, to formulate a drug solution or drug suspension with the appropriate concentration, a solid water-insoluble drug needs to be dissolved or suspended in a suitable nonvolatile solvent system. The ideal liquid vehicles are inert, preferably water-miscible, organic solvent systems with a high boiling point and a relatively low viscosity, such as glycerin, propylene glycol, liquid polyethylene glycols, polysorbates, fixed oils, or propylene glycol. This is an unfamiliar "Powder Solution Technology" which utilizes coating materials, liquid drugs, drug suspensions incorporated with appropriate carriers, and absorption and adsorption efficiency to formulate a powder that is compressible, dry-looking, free-flowing, and non-adherent [7]. Liquisolid formulations yield rapid release rates, which can be effectively applied to water-insoluble solid drugs, liquid lipophilic drugs, or water-insoluble solid drugs dissolved in non-

volatile solvents. The resulting liquid drug can be easily compressed, flow freely, and appear dry and non-adherent. Given that the medication is in liquid form, it is either molecularly dispersed or solubilized. Liquisolid tablets of water-insoluble medicines exhibit an enhanced dissolution profile and greater bioavailability as a result of increased wetting and increased surface area for dissolution. [8].

CLASSIFICATION OF LIQUISOLID SYSTEM

A. Based on the type of liquid medication contained therein, liquisolid systems may be

Classified into three subgroups:

1. Powdered drug solutions

2. Powdered drug suspensions

3. Powdered liquid drugs

B. Based on the formulation technique used, liquisolid systems may be classified into two categories:

1. Liquisolid compacts:

Refers to the "liquisolid systems" category, which includes instant sustained-release tablets and capsules.

2. Liquisolid Microsystems:

refers to capsules produced from "liquisolid systems" plus an addition that produces a unit size that may be as much as five times smaller than a liquisolid compact [9].

CONCEPT

Both absorption and adsorption occur when the drug dissolved in the liquid vehicle is incorporated into a carrier material with a porous surface and closely matted fibers inside, like cellulose. This means that the liquid is first absorbed inside the particles and is then captured by their internal structure; after this process reaches saturation, the liquid is then adsorbed onto the internal and external surfaces of the porous carrier particles. Then, the coating material having high adsorptive properties and a large specific surface area gives the liquisolid system the desirable flow characteristics.

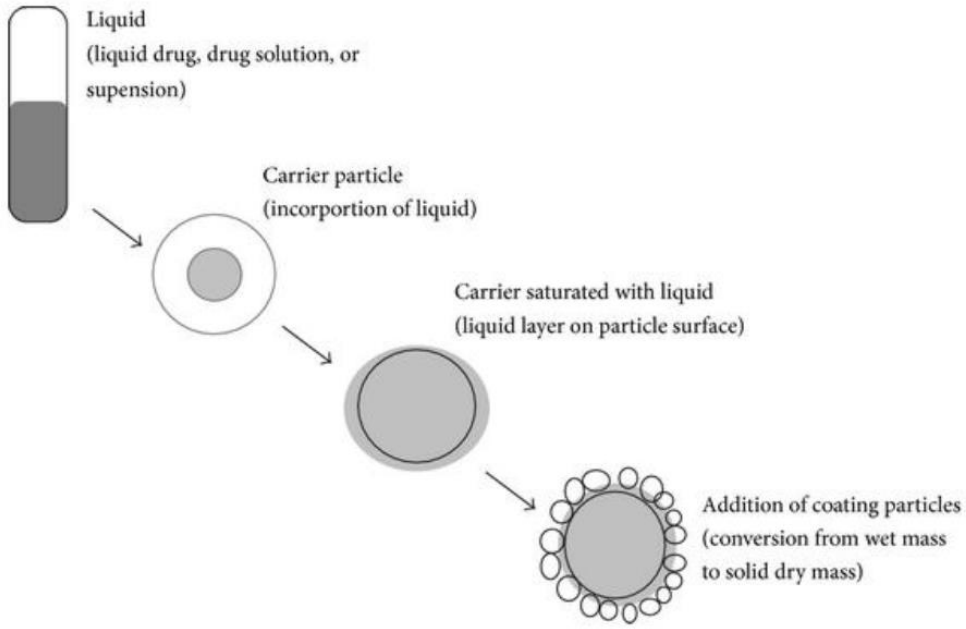

Figure No. 2: Theoretical Concept of Liquisolid System

One of the proposed explanations for the enhanced dissolution rate from the liquisolid compacts is the wettability of the compacts by the dissolution media. By decreasing the interfacial tension between the tablet surface and the dissolution medium, the nonvolatile solvent in the liquisolid system makes it easier for drug particles to be wettable [10].

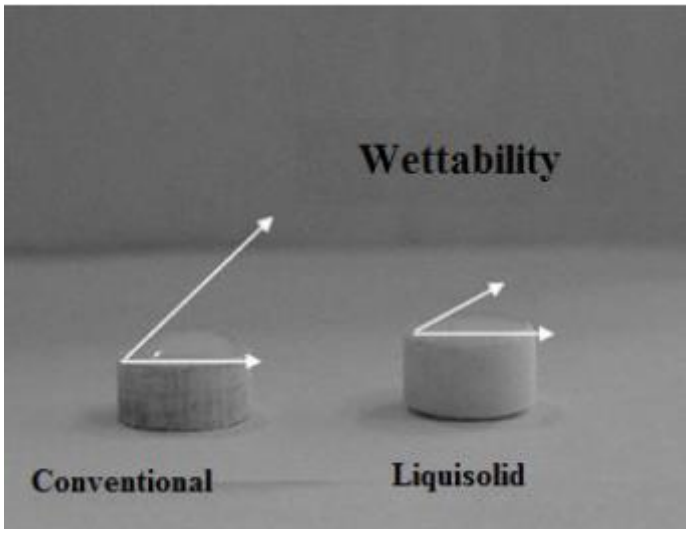

Figure No. 3: Wetting Property of Liquisolid system.

MATHEMATICAL MODEL TO DESIGN LIQUISOLID SYSTEM

A mathematical model designed by Spireas et al. was employed as the formulation design model for the liquisolid tablets to achieve good flow behavior and compressibility of

liquisolid systems. Adequate drug candidates, appropriate non-volatile solvent, carrier, and coating materials are prerequisites for this. Liquisolid compact preparation requires certain quantities of excipients, such as carrier and coating ingredients, based on the liquid loading factors (Lf) and flowable liquid retention potential values (Φ -value).

Flowable liquid retention potential values (ϕ- value)

The maximum quantity of a particular non-volatile liquid that can be retained inside its bulk (w/w) while preserving adequate flowability is known as the powder's flowable liquid retention potential (Φ-value). Consequently, for each formulation, we must find the liquid retention potential value for the coating (TCO-value) and carrier (\CA-value) materials in order to calculate the number of excipients. For the specified vehicle and powder system, these values are constant.

Liquid loading factors (lf)

It is defined as the weight ratio of the liquid formulation (W) and the carrier material (Q) in the system.

$$Lf = W/Q\text{------} \quad (1)$$

(W is the weight of the liquid medication (the drug + non-volatile liquid vehicle) and Q is the weight of the carrier.)

R represents the ratio between the weights of the carrier (Q) and the coating (q) material present in the formulation. The optimum weight of the coating material (q) could also be obtained (Equation 2).

$$R = Q/q\text{------} \quad (2)$$

The liquid load factor that ensures acceptable flowability (Lf) can be determined by.

$$Lf = \Phi CA + \Phi CO\ (1/R)\ \text{-----} \quad (3)$$

By calculating Lf and W, we can calculate the amount of Q required for the liquisolid system [11].

MECHANISM OF ENHANCED DRUG RELEASE FROM LIQUISOLID SYSTEMS:

The mechanisms involved are an increased surface area of the drug available for release, an increased aqueous solubility of the drug, and an improved wettability of the drug particles.

Increased drug surface area:

The drug within the liquisolid system is dissolved in the liquid vehicle in which it is positioned in the powder substrate in a solubilised, molecularly dispersed state. Therefore, the surface area of the drug present for release is much greater than that of drug particles within directly compressed tablets. The release rate of the drug present in the compact decreases due to an increase in drug content beyond solubility limit which in turn increases the undissolved drug in the liquid vehicle. The release rates are directly proportional to the fraction of the molecularly dispersed drug (FM) in the liquid formulation. FM is defined by Spireas as the ratio between the drug's solubility (Sd) in the liquid vehicle and the actual drug concentration (Cd) in this vehicle carried by each system [12].

Therefore,

$$FM = Sd/Cd$$

Where FM =1 if Sd ≥ Cd

Increased aqueous solubility of the drug:

In addition to the first mechanism of improved drug release, it is anticipated that liquisolid systems could enhance Cs, the drug's solubility. The relatively small quantity of liquid vehicle present in the liquisolid compact is insufficient to improve the overall solubility of the drug in the dissolution medium. The amount of liquid vehicle that diffuses out of a single liquisolid particle along with the drug molecules, however, may be sufficient to increase the drug's aqueous solubility if the liquid vehicle acts as a co-solvent at the solid/liquid interface between the release medium and the individual liquisolid primary particle [13].

Improved wetting properties:

The liquid vehicle's capacity to act as a surface active agent or have a low surface tension improves the wetting of the liquisolid particles. Measurements of contact angles and water rising times have been used to confirm the wettability of the systems. [14].

ADVANTAGES:

1. It is an effective method for poorly water-soluble drugs with high permeability.

2. It is suitable for insoluble liquids and solid drugs.

3. It is an effective method for increasing the bioavailability of poorly water-soluble drugs.

4. It is a suitable approach for the enhancement of dissolution profiles.

5. It is a method for formulating powdered liquid medications.

6. This technique is a suitable approach for formulating into immediate release or sustained-release dosage forms.

7. Compared to soft gelatin capsules, the production cost is lower with this liquisolid technology.

8. Drug can be molecularly dispersed in the formulation.

9. The release rate of a drug can be modified by utilizing the suitable formulation components.

10. Add a coloring agent to the liquid vehicle to make the dosage form stand out.

11. Industrial production capability is also conceivable.

12. To use less excipients in comparison to formulations that use solid dispersions, for example.

13. Drugs are manufactured in tablet or encapsulated dosage form and kept in a solubilized liquid state with established or enhanced wetting characteristics that increase drug dissolving profiles [15].

DISADVANTAGES:

1. For liquid-solid systems, low drug loading capabilities are required.

2. It requires excipients with higher levels of efficacy and adsorption capacity, which should lead to a quicker release of the drug from a smaller tablet.

3. To maintain flowability and compatibility requirements, more coating and carrier materials are required.

4. In a liquid-solid system, drugs need to be highly soluble in non-volatile liquid carriers.

5. A liquid-solid approach is usually used to give drugs that are insoluble in water.

6. Liquisolid systems are not suitable for formulating high doses of water-insoluble drugs [16].

APPLICATIONS

Liquisolid compact technique is an effective approach for increasing the bioavailability of water-insoluble drugs. Various water-insoluble drugs that dissolve in various non-volatile solvents have been made into liquisolid compacts.

1. Various drugs can be introduced into liquisolid compacts.

2. Rapid release rates.

3. Suitable for water-insoluble solid or liquid lipophilic drugs.

4. Drug release is sustained.

5. Enhanced solubility and dissolution.

6. Flow and compressibility.

7. Designing controlled-release medication.

8. Increased bioavailability.

9. Usage in probiotics.

10. Improved drug photo stability. [17]

ORODISPERSIBLE TABLETS

Orodispersible tablets (ODTs) are oral solid dosage forms that dissolve in the oral cavity within a minute without requiring the intake of water. They are also known as fast dissolving tablets, mouth dissolving tablets, quick dissolving tablets, melt-in-mouth, porous tablets, orally disintegrating tablets and rapimelts tablets. Orodispersible drug delivery systems were

originally created in the late 1970s as an alternative to capsules, syrups, and tablets for geriatric and pediatric patients who were encountering difficulties ingesting typical oral solid-dosage forms. [18]. ODT terminology has been approved by United States Pharmacopoeia, British Pharmacopoeia 3-6, and Centre for Drug Evaluation and Research (CDER). US FDA defined ODT tablets as "A solid dosage form containing medicinal substances which disintegrates rapidly usually within a matter of seconds, when placed upon the tongue". European pharmacopeia also adopted the term "orodispersible tablet" as a tablet that is to be placed in the mouth where it disperses, rapidly before swallowing despite various terminologies used [19].

CHARACTERISTICS OF IDEAL ORODISPERSIBLE TABLETS

i) They should dissolve or disintegrate in the mouth in a few seconds, requiring no water for consumption.

ii) They should have a pleasant sensation in mouth.

iii) Leave minimal or no residue in the mouth following oral ingestion.

iv) Allowing higher drug loading capacities.

v) They should be compatible with taste-masking agents and other excipients.

vi) They must be compatible with taste-masking agents and other excipients.

vii) They should be less sensitive to external variables such as humidity and temperature.

viii) Ensure mechanical strength to endure rigorous manufacturing and post-production handling.

ix) They should be compatible with existing processing and packaging machinery. [20]

ADVANTAGES OF ORODISPERSIBLE TABLETS

i) For patients who are unable to swallow (e.g. old, stroke victims, bedridden), or refuse to swallow (e.g. pediatrics, geriatric, and psychiatric patients).

ii) Ensuring patient compliance for those who are bedridden, travelling, or have limited access to water.

iii) Improved mouth feel can transform the perception of medication as a "bitter pill," especially for pediatric patients.

iv) Advantages of solid medication over liquid formulations include ease of administration and precise dose.

v) Drugs are more quickly absorbed in the mouth, pharynx, and esophagus, leading to a faster onset of action.

vi) Pregastric absorption improves bioavailability, reduces dose, and enhances clinical performance by minimizing side effects.

vii) New business prospects include product diversification, line extension, life-cycle management, exclusivity in product advertising, and patent life extension. [21].

DISADVANTAGE OF ORODISPERSIBLE TABLETS (ODTS)

i) Immediate pharmacological intervention is not feasible.

ii) May require frequent administration.

iii) Dose dumping may happen.

iv) Limits the ability to accurately alter doses.

v) ODT requires particular packaging to ensure product stability and safety.

vi) Typically lacks mechanical strength. As a result, careful handling is essential.

vii) Improper formatting might cause an unpleasant taste and/or grittiness in the tongue. [22, 23].

CRITERIA FOR ODTS DRUG CANDIDATES

Several criteria must be considered when selecting drug candidates for administration in ODT dose forms:

i) Drugs with considerably different pharmacokinetic profiles in comparison to the same dose administered in a conventional dosage form. E.g., selegiline, apomorphine, buspirone, etc.

ii) The drugs that produce a significant amount of toxic metabolites mediated by first-pass liver metabolism and gastric metabolism and for drugs that have a substantial fraction of absorption in the oral cavity and segments of the pre-gastric GIT.

iii) Drugs that may diffuse and partition into upper GIT epithelium (log P > 1, or preferred > 2) and permeate oral mucosal tissue are suitable for ODT formulations.

iv) Patients using anticholinergic medicines may not be appropriate candidates for these treatments.

v) Patients with Sjogren's syndrome or dry mouth due to low saliva production may not be suitable for ODT formulations.

vi) ODT formulation is not suitable for drugs with a short half-life, requires frequent doses, have an unpleasant taste that cannot be masked, or requires controlled release. [24]

COMPONENTS OF LIQUISOLID SYSTEM

LIQUID VEHICLE

The liquid vehicle in liquisolid systems should be orally safe, inert, and less viscous. Propylene glycol, glycerin, PEG-200 and 400, and polysorbate 20 and 80 are some examples of water-miscible, non-volatile solvents that are commonly used. A drug's solubility in a liquid medium is directly proportional to its rate of dissolution. The higher the drug's solubility in the solvent, the greater the fraction of the molecularly distributed drug. Solvents often used in LS systems have a high boiling point, are non-volatile, water-miscible, and are not excessively viscous solvents. Propylene glycol (PG) is used to dissolve and homogenise the active component in the formulation. The choice of any liquid vehicle is determined by the purpose of the study. For dissolution enhancement of a specific drug, the liquid vehicle with the highest ability to solubilize the drug will be selected, whereas for prolonged drug release, the liquid vehicle with the lowest capacity for solubilizing the drug will be chosen. Some reports show that liquid vehicle can act as a binder at low concentrations. [25].

CARRIERS

The carriers employed in liquisolid systems should have a porous surface and a high liquid absorption capacity. The features of carriers, such as liquid absorption capacity, are vitally essential when formulating a liquisolid system. Examples of carriers include microcrystalline

cellulose (MCC), Neusilin lactose, sorbitol, and starch, Fujicalin Avicel pH 102 and 200, and Eudragit RL and RS. A substantial amount of carriers is necessary to convert liquid medication into a dry, free-flowing, compressible powder mixture. The choice of a carrier is determined by its liquid, binding size, powder flowability, and compressibility. Based on their chemical structure, they are categorized into four classes. (Table 1). [26]

Table No. 1: Liquisolid Formulation parameters of various powder excipients which are commonly employed as liquid vehicles.

CARRIER CATEGORY	CARRIER	SURFACE AREA (m^2/g)
Cellulose and cellulose derivatives	Microcrysalline cellulose, hypermellose	~1.18
Saccharides	Lactose	~0.35
	Sorbitol	~0.37
Silicates	Magnesium aluminometasilicate	110-300
	Kaolin diosmectite	~ 24
Others	Anhydrous dibasic calcium phosphate	30
	Polymethacrylates	
	Starch	0.60
	Magnesium carbonates	10

COATING MATERIALS

They possess fine, flow-enhancing and highly adsorptive properties. Examples include Aerosil® 200, Neusilin® , calcium silicate. They serve an important function in coating the wet carrier particles and forming a dry, non-adherent, free-flowing powder by adsorbing any excess moisture. Neusilin® US2 can be utilized as both a coating and carrier material. [27].

ADDITIVES

The disintegrant is the most commonly used excipient in the liquisolid system. They have a significant influence on drug release (rapid disintegration). Examples include sodium starch glycolate, croscarmellose sodium, hydroprophyl cellulose, polyvinylpyrrolidone (PVP), and hypromellose. Additives are known to incorporate a large amount of drugs into liquisolid systems, therefore reducing the tablet weight. [28].

METHOD OF PREPARATION

DIRECT COMPRESSION:

Liquid drugs can be converted into dry liquisolid systems without undergoing any further chemical modifications. If a solid water-insoluble drug is to be produced as a liquisolid compact, it must first be dissolved or suspended in a suitable non-volatile solvent system to produce a drug solution or suspension at the required concentration. Next, a specified amount of the prepared drug solution, suspension, or liquid medicine is mixed into a certain amount of carrier material, which should be porous and have adequate absorption characteristics. The resulting wet mixture can be turned into a dry, non-adherent, free-flowing, and easily compressible powder by simply adding and mixing the specified quantity of coating material. Excipients possessing fine, highly adsorptive particles are appropriate for this phase. Before compression or encapsulation, various additives such as lubricants and super-disintegrants are added to the final liquisolid system to form orodispersible liquisolid compacts [29].

To make liquisolid tablets, the promising flowable liquisolid powders were compressed using the direct compression method. The liquisolid powders were then combined with a lactose (filler) and croscarmellose sodium (superdisintegrant) in a glass mortar for 10 minutes. The solutions were then lubricated with sodium stearyl fumarate for an additional 3 minutes. Finally, 100 mg of each mixture was manually fed into the die of a single-punch tablet press machine equipped with flat-faced punches to manufacture liquisolid tablets. [30].

PREFORMULATION STUDIES

Solubility of drug:

It is carried out by preparing saturated solution of the drug in different solvents. This saturated solution is prepared by adding excess amount of drug in non-solvent. This solution is shaken with shaker for a specific period of time than it is filtered and analyzed under UV spectrophotometer [31].

Determination of the angle of slide:

The angle of slide is used to measure the flow properties of powders. To determine the angle of the slide, weigh the needed amount of carrier material and position it at one end of a metal plate with a polished surface. The end is gradually elevated until the plate becomes angular to

the horizontal, at which point the powder will slide. This is referred to as the angle of slides. The angle of 33º is considered optimal. [32].

Determination of flowable liquid retention potential (Φ value):

The "flowable liquid-retention potential" (Φ-value) of a powder material refers to its ability to retain a given amount of liquid while retaining flow characteristics. The Φ-value refers to the amount of liquid that can be held per unit weight of powder material, resulting in a flowable liquid/powder mixture. The Φ values are calculated using the equation.

$$\Phi \text{ value} = \text{weight of liquid/weight of solid}$$

Calculation of liquid load factor:

Different concentrations of non-volatile solvents are used to dissolve the drug. Such liquid medication is mixed with the carrier coating material admixture and blended. Drug loading factors are calculated using an equation to determine the amount of carrier and coating ingredients in each formulation.

$$Lf = \text{weight of liquid medication/weight of carrier material}$$

Liquisolid compressibility test (LSC):

To determine Φ values, the liquisolid compressibility test involves preparing uniform liquid or powder admixtures, compressing them to tablets, assessing average hardness, determining average liquid content of crushed tablets, and determining plasticity, sponge index, Φ value, and Lf. [33]

Flow behavior

The flowability of a powder is crucial in the production of pharmaceutical dosage forms in order to reduce high dose fluctuations. The angle of repose, Carr's index, and Hausner's ratio were used to make certain that the liquisolid systems had suitable flow properties.

Angle of repose

This is the maximum angle possible between the surface of a pile of powder and the horizontal plane. 10 gm of powder was allowed to flow by funnel from 4 cm of height from the base. The height of the pile and diameter of the base was measured and calculate the angle of repose by following the formula.

$$\tan \theta = h/r$$

$$\theta = \tan\text{-}1\ h/r$$

Where, θ = angle of repose, h = Height of the heap, r = Radius of the heap.

Bulk density

An accurately weighed quantity of powder, which was previously passed through sieve # 40 [USP] and carefully poured into a graduated cylinder. Then after pouring the powder into the graduated cylinder, the powder bed was made uniformly without disturbing. Then the volume was measured directly from the graduation marks on the cylinder as ml. The volume measured was called the bulk volume and the bulk density is calculated by following the formula;

Bulk density = Weight of powder/Bulk volume.

Tapped density

The weighed amount of powder mass is poured to a graduated measuring cylinder and tapped a fixed number of times and the volume is determined (Vt). Tapped density can be given by,

Tapped density = Weight of powder/Tapped Volume.

Carr's index [compressibility index]

It determines the characteristic nature of powders and granules. It can be calculated from the following equation

Carr's index = Tapped density-Bulk density/Tapped density X 100.

Hausner's ratio

Hausner's ratio is used to determine the flow property of powder and granules. This can be calculated by the following formula

Hausner's ratio = Tapped density/Bulk density.

Table No. 2: Flowability characteristics based on Hausner ratio and compressibility index [34].

Compressibility index	Hausner's ratio	Flowability
5-15%	1.05-1.18	Excellent
12-16%	1.14-1.19	Good
18-21%	1.22-1.27	Fair-passable
23-35%	1.30-1.54	Poor
33-38%	1.49-1.69	Very poor
>40%	>1.67	Very very poor

EVALUATION OF LIQUISOLID TABLETS

Weight variation

Twenty tablets were weighed to determine the average weight. The weight variation of each tablet was then determined, and the percentage deviation from the mean for each tablet should not exceed specified limits in terms of percentage deviation. According to USP, none of the individual tablet's weight should be less than 90% and more than 110% of the average weight [35].

Thickness

The thickness of the tablet was measured by Vernier Caliper.

Hardness

The mechanical strength of a tablet is measured using a hardness tester [Monsanto hardness tester]. A tablet's mechanical strength correlates with its resistance to breakage or attrition. Acceptance criteria: Not less than 4.0 Kg/cm^2 [36].

Friability

It was determined using the Roche friability, the percentage loss in tablet weight before and after 100 revolutions of tablets was calculated and taken as a measure for friability. Acceptance criteria: Friability is not more than 1.0 % [37].

Contact Angle Measurement

The imaging approach is used to determine wettability by measuring the contact angle of liquisolid tablets. The most common technique is to directly measure the contact angle of a drop of liquid resting on a solid planar surface, known as the imaging method. A saturated solution of the drug in dissolution media is made, and a drop of this solution is applied to the surface of the tablets. The contact angles are computed by measuring the height and diameter of a sphere dropped on the tablet [38].

X-ray diffraction (XRD)

XRD investigations use an X-ray diffractometer to determine the crystalline properties of a liquisolid compacts. The experiment employs a current of 30 mA and a copper target with a voltage of 40 kV. The equipment operates at a scanning angle of 5 to 70 degrees and a counting rate of 0.4 s per step. The shift in the peak pattern from a distinct and sharp to a random pattern provides evidence concerning the conversion of the crystalline character of medications to amorphous forms of drugs [39].

Scanning Electron Microscopy (SEM)

This approach aids in assessing the surface behavior of the drug, which indicates whether it has crystallized from the liquidsolid system. The drug's solubility in a liquisolid system indicates the disappearance of these molecular forms [40].

Differential Scanning Calorimetry (DSC)

DSC investigations can be used to analyze the thermal behavior of pure components and liquisolid compacts. About 3-5 mg of the sample is vacuum-packed in aluminum pans and heated at a constant rate of 10 °C/min across a temperature range of 30 to 300 °C. The overall thermal behavior is examined using unoccupied aluminum pans as standards and nitrogen purging. The absence of the drug's distinctive peak in the presence of excipients is an indication of drug incompatibility with excipients, as well as changes in the crystalline pattern of the drug, which may be molecular-level alterations from a crystalline to an amorphous pattern [41].

CONCLUSION

When compared to conventional tablets, the Liquisolid technology increases the aqueous solubility, absorption, and dissolving rate of water-insoluble drugs, improving their bioavailability. Sustaining the drug's release from dosage forms also aids in its optimal and appropriate use. Improving drug bioavailability necessitates both of these applications. Orodispersible tablets can help reduce dosage and have a rapid onset of action due to their rapid absorption by pregastric absorption of the drug from the mouth, pharynx and esophagus as saliva flows down and beneficial to reduce dose. Combining the Liquisolid technique with the Orodispersible DDS may improve the drug's solubility and dissolving rate. The Liquisolid approach can produce a rapid onset of action with a lesser amount of the drugs, while the Orodispersible DDS can do the same. This combination may also promote patient compliance. Liquisolid technology is among the most effective methods. Since liquisolid formulations have good flow and compaction characteristics and need little economic input during manufacture, it is considered a multipotential and promising technology for the creation of dosage forms. It may also be industrially feasible. To make the dosage form more affordable, liquisolid technology will be utilized to increase the rate at which drugs that are poorly soluble in water release.

REFERENCES

1. Andrew Chekwube Ezegbe, Grace Amarachi Ezegbe, Josephat Ikechukwu Ogbonna, Sabinus Ifeanyi Ofoefule. A Review on Liquisolid: A Novel Technique for Enhancement of Solubility and Bioavailability of Poorly Water-Insoluble Drugs. Science Frontiers. 2023: 4(2):17-24.
2. Anand D. Savkare, Malavi R. Bhavsar, Vishal D. Gholap, Pooja M. Kukkar. Liquisolid Technique: A Review. IJPSR, 2017: 8(7):2768-2775.
3. Egla, M., and S. N. A. A. Hammid. Design Zolmitriptan Liquisolid Orodispersible Tablets and Their In Vitro Evaluation. International Journal of Pharmacy and Pharmaceutical Sciences, Jan. 2017: 9(1):297-03.
4. Shah R., Banwait H., Rathi S. Patni P. Liquisolid Compacts Based Orodispersible Tablets to Enhance Solubility of Atorvastatin using Experimental Design J Pharm Sci Bioscientific Res. 2017: 7(3):245-250.
5. Yadav VB, Yadav AV. Improvement of Solubility and Dissolution of Indomethacin by Liquisolid and Compaction Granulation Technique. J. Pharm. Sci. & Res. 2009: 1(2): 44-51.
6. K. Kavitha, K. N. S. LovaRaju, N. S. Ganesh and B. Ramesh, Effect of dissolution rate by liquisolid compacts approach: An overview, Der Pharmacia Lettre 3 (2011) 71–83.
7. Ashutosh Badola, Pooja Arya. Formulation And Evaluation Of Orodispersible Liquisolid Compacts Of Ketoconazole Using Co-Processed Superdisintegrants. JETIR. 2020: 7(12): 240-257.
8. Chella N, Narra N, Rama Rao T. Preparation and Characterization of Liquisolid Compacts for Improved Dissolution of Telmisartan. J Drug Deliv. 2014:1–10.
9. N. Madhavi, O. Likitha, V. T. Iswariya, K. Mary Swarnalatha, T. Rama Rao. A Review on Liqui-Solid Compaction of Solid Dispersion. Journal of Coastal Life Medicine. 2022: 10(1):536–545.
10. Sahil M. Gavali, Sharad S. Pacharane, Shirish V. Sankpal, Kisan R. Jadhav, Vilasrao J. Kadam. Liquisolid Compact: A New Technique For Enhancement Of Drug Dissolution. IJRPC. 2011: 1(3).

11. Abdul Hasan Sathali A., Deepa C. Formulation of liquisolid tablets of candesartan cilexetil: Int. J. Res. Pharm. Sci. 2013: 4(2): 238-49.
12. Vinoth P, Rajalakshmi AN, Stephen P; Orodispersible liquisolid compacts: A novel approach to enhance solubility and bioavailability; PharmaTutor; 2018: 6(6): 28-35.
13. Patel DJ, Patel JK and Pandya VM. Improvement in the dissolution of poorly water soluble drug using media milling technique. Thai J Pharma Sci. 2010: 34:155-64.
14. Spireas S, Jarowski CL and Rohera BD. Powdered solution technology: principles and mechanism. Pharma Res. 1992: 9:1351-1358.
15. Nagabandi VK, Ramarao T and Jayaveera KN. Liquisolid Compacts: A Novel Approach to Enhance Bioavailability of Poorly Soluble Drugs. Int J Pharm Bio Sci. 2011: 1(3):89-102.
16. Neha Kumari*, Saurabh Mishra A review on solubility enhancement by liquisolid technique as a novel approach. Scope. 2023:13(1).
17. Vijaykumar N, Sridhar T, Anilkumar C, Pragathi K. Enhancement of oral bioavilability of naproxen by liquisolid compaction technology: in vitro, in vivo evaluation. Indo Am J Pharm Res. 2013: 3:1359-69.
18. Vinita Chaurasia, Vikas Kumar, Brajesh K Tiwari, Aakancha Jain, Dharmendra Jain. Orodispersible Tablets: An Overview Of Technology. IJARR. 2016 :1(6): 156-172
19. Suresh Bandari, Rajendra Kumar Mittapalli, Ramesh Gannu, Yamsani Madhusudan Rao. Orodispersible tablets: An overview. Asian Journal of Pharmaceutics. 2008.
20. Sharma S., Gupta G. D., Fast Dissolving Tablets, The Indian Pharmacist, 7, 2008, 33.
21. Gupta A, Mishra AK, Gupta V, Bansal P, Singh R, Singh AK. Recent trends of fast dissolving tablet -An overview of formulation technology. Int J Pharm Biol Arch. 2010: 1(1):1-10.
22. Chiman B, Isha S. Development of fast disintegration tablets as oral drug delivery system - A review. Indian J Pharm Biol Res. 2013: 1(3):80-99.
23. Ashish P, Harsoliya MS, Pathan JK, Shruti S. A review- Formulation of mouth dissolving tablet. Int J Pharm Clin Sci. 2011: 1(1):1-8.
24. Prateek S, Ramdayal G, Kumar SU, Ashwani C, Ashwini G, Mansi S. Fast dissolving tablets: A new venture in drug delivery. Am J PharmTech Res. 2012: 2(4):252-79.
25. Spireas, S., & Sadu, S. Enhancement of prednisolone dissolution properties using liquisolid compacts. International Journal of Pharmaceutics. 1998: 166(2): 177-188.
26. Mei Lu, Haonan Xing, Jingzheng Jiang, Xiao Chen, Tianzhi Yang, Dongkai Wang, Pingtian Ding. Liquisolid technique and its applications in pharmaceutics. Asian Journal of Pharmaceutical Sciences. 2017: 12(2): 115-123.
27. Chaursiya Ajay C., Patel Jignesh S., Dumpala Rajesh L. Liquisolid Compaction Technique For Enhancing Solubility And Improvement Of Dissolution. EJPMR. 2020: 7(9): 121-126.
28. Imran khan*, M. Idreesh khan, Unis khan. Liquisolid Technology: An Emerging and Advance Technique for Enhancing Solubilization. PharmaTutor. 2014; 2(60): 31-41.
29. Hamsanandini J., Parthiban S., Vikneswari A., Sentil kumar G.P., Tamiz Mani T.Formulation and Evaluation of Orodispersible Liquisolid Compacts of Meloxicam using Banana Powder as a Natural Superdisintegrants.Asian Journal of Research in Biological and Pharmaceutical Sciences. 2015: 3(1):25-38.
30. Bary A, Louis D, Sayed S.Olmesartan medoxomil surface solid dispersion-based orodispersible tablets: formulation and in vitro characterization. SCI. TECH. 2014: 24 (6):665-672.
31. Patil Jayesh Arun, Deshmukh T.V. A Review: Innovational Approach to Enhanced Dissolution by Using Liquisolid Compact Technique. Ijppr.Human. 2023: 26 (3): 141-155.
32. Manpreet Kaur, Rajni Bala, Sandeep Arora. Liquisolid Technology: A Review. PHARMANEST - An International Journal of Advances in Pharmaceutical Sciences. 2013: 4(1).
33. Spireas S. Liquisolid systems and methods of preparing same. United State Patent, 2002: 6423,339.
34. Viswanath.V, Somasekhar. G. Stability Enhancement Of Lovastatin By Liquisolid Compaction Technique. JGTPS. 2014: 5(3): 1933 – 1939.
35. Parmar K, Patel J, Sheth N. Fabrication and characterization of liquisolid compacts of Embelin for dissolution enhancement. J Pharm Investig. 2014: 44: 391-8
36. Lachman L, Lieberman H, Kanig J. The theory and practice of industrial pharmacy, 3rd Edn, Varghese Publishing House, Mumbai; 1987.

37. Kanagathara N, Shenbagarajan P, Esther JC, Thirunavukkarasu C. Fourier Transform Infrared Spectroscopic Investigation on Nifedipine. International Journal of Pharma and Bio Sciences. 2011: 1(2): 52-56.
38. Ajit S. Kulkarni, Nagesh H. Aloorkar, Madhav S. Mane and Jayashree B. Gaja. Liquisolid Systems: A Review. International Journal of Pharmaceutical Sciences and Nanotechnology. 2010: 3(1).
39. Sanjay PD, Deepak M, Bhanudas SR. Liquisolid technology: A technique for formulation with enhanced bioavailability. World J Pharm Pharm Sci. 2013: 2:368-81.
40. Khaled KA, Asiri YA, El-Sayed YM. In vivo evaluation of hydrochlorothiazide liquisolid tablet in beagles dogs. Int J Pharm. 2001: 222:1-6.
41. Thakur N, Khokra S, Sharma D, Purohit R, Arya V. A review on pharmaceutical application of liquisolid technique. Am J Pharma Tech Res. 2011: 1:1-18.